

**Gasworks.** A hydrogenase (structure above) funnels in protons from water and electrons and combines them into hydrogen molecules (right).

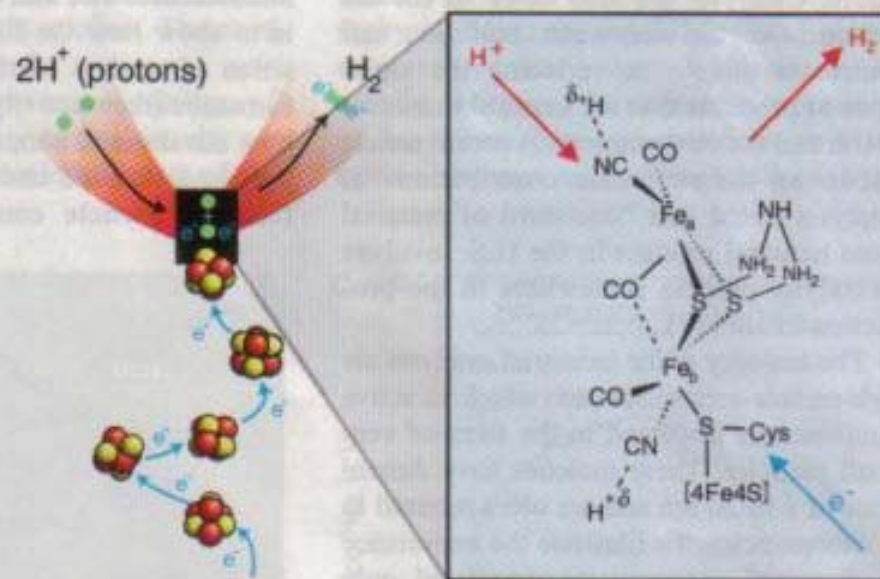
M first suggested  
dinated to the iron  
a mixed oxidation  
necessary electrons  
ams. Exactly how

catalyst, the Illinois  
researchers re-  
placed one of the  
cyanides with an  
analogous phos-

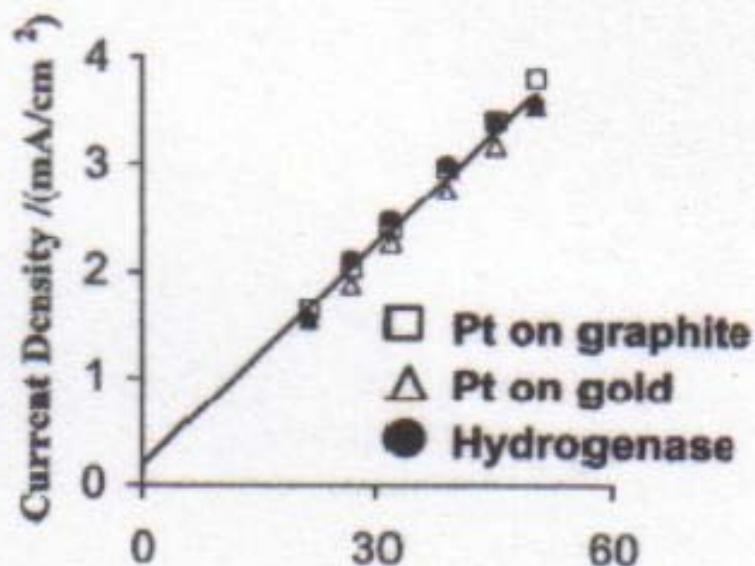
containing both sulfur and nitrogen. Adding a small amount of acid—a source of protons—led to some hydrogen gas production, but that reactivity died quickly.

Reasoning that they needed to tweak the electronic properties of the iron atoms in the

classic high school electrolysis experiment running electricity through two electrodes stuck in a beaker of water to produce hydrogen at one electrode and oxygen at the other. Today, electrolysis uses too much electricity to be an economical source of hydrogen. But coating the hydrogen-producing electrode with a hydrogenase-derived catalyst might be just the ticket for making it cost-effective. Similarly, catalysts based on the nickel-iron hydrogenase could improve the hydrogen-oxidizing process that's central to hydrogen

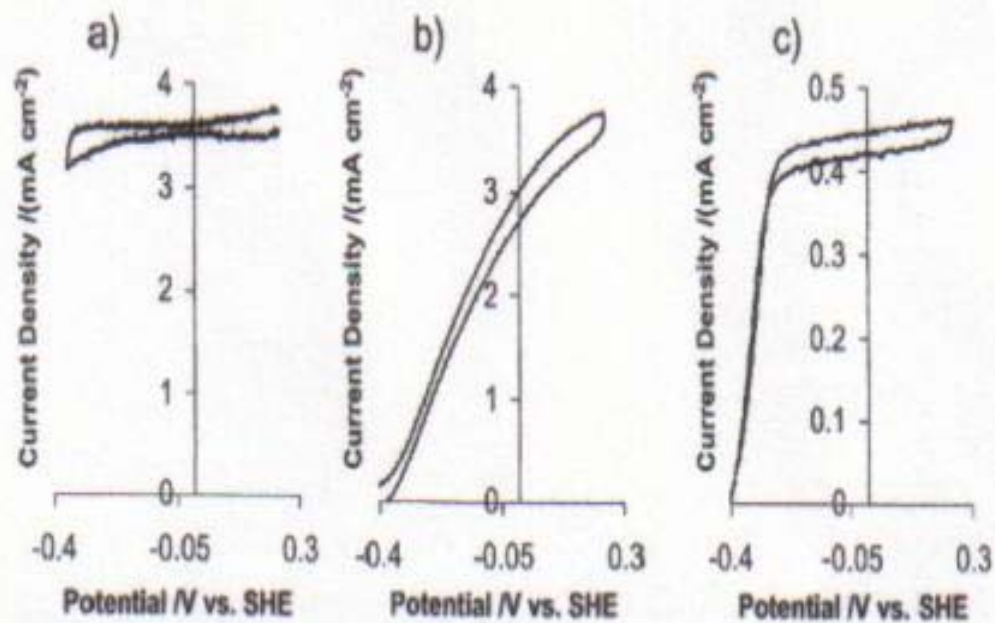


J. Alper, “Water Splitting Goes Au Naturel”, *Science*, 299, 1686-1687 (2003).



**Fig. 1** Levich plots for hydrogen oxidation currents from hydrogenase and platinum at +0.242 V vs. SHE, 45 °C and pH 7 under 1 atm hydrogen. The line of best fit is from the hydrogenase data. Platinum currents are from chronoamperometric experiments in which the potential was held at +0.242 V vs. SHE and the rotation rate varied. Hydrogenase currents are from cyclic voltammetry experiments at 1 V s<sup>-1</sup>, since maintaining the film at an oxidative potential over extended periods inactivates the enzyme.<sup>9</sup>

A.K. Jones, E. Sillery, S.P.J. Albracht, and F.A. Armstrong, “Direct comparison of the electrocatalytic Oxidation of hydrogen by an enzyme and a platinum catalyst”, Chem. Commun., 866-867 (2002).



**Fig. 2** Potential dependence of hydrogen oxidation currents for platinized gold and hydrogenase/PGE rotating-disk electrodes at pH 7, 45 °C, rotation speed 2500 rpm. (a) Platinized gold; 1 atm hydrogen, 1 V s<sup>-1</sup>. (b) Hydrogenase; 1 atm hydrogen, 1 V s<sup>-1</sup>. (c) Hydrogenase; 0.1 atm hydrogen, 0.1 V s<sup>-1</sup>.

A.K. Jones, E. Sillery, S.P.J. Albracht, and F.A. Armstrong, "Direct comparison of the electrocatalytic Oxidation of hydrogen by an enzyme and a platinum catalyst", Chem. Commun., 866-867 (2002).